

Advanced Visualization Techniques of Hot-Jet Combustion of Lean and Ultra-Lean Substances

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Research has been conducted on ignition of natural gas as a potential replacement for fossil fuels. A reason natural gas is not widely used and adapted is because of the harmful emissions created when combusted in rich mixtures, but if the gas can be burned at a lean or ultra-lean equivalence ratio, these emissions can be reduced or even eliminated. One method of burning lean and ultra-lean substances is by use of hot-jet ignition. This method ignites the substance near its combustion temperature, reducing the harmful emissions. This method is not yet fully understood, and so research must be done to analyze the hot-jet itself and how it ignites or fails to ignite the substance. For measuring ignition, the main chamber and prechamber are filled with methane-air mixtures with varying conditions. Next the prechamber is ignited using a spark plug that then creates a hot-jet of these combustion products to penetrate into the main chamber. The improved system will use a modified Schlieren method to observe the phenomenon, and an IR Diagnostics system to record images and temperatures. Using these procedures and recording if ignition happened or not, a basis can be determined for creating conditions optimal for igniting lean substances. Ignition in the main chamber is dependent upon the characteristics of the penetrating hot-jet as well as the static characteristics of the main chamber gas. The key characteristics that have the greatest effect upon ignition are best recorded using the new system; giving a full range of information required.